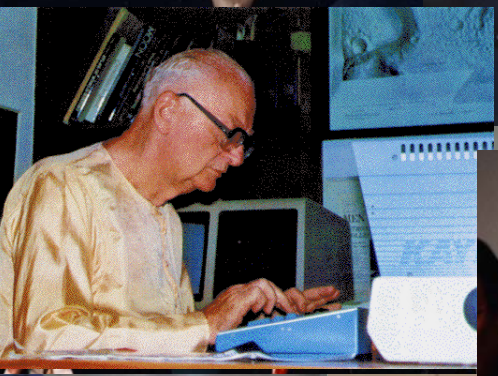
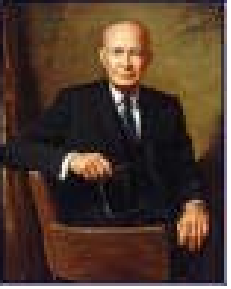

CGSR
Center for Global Security Research

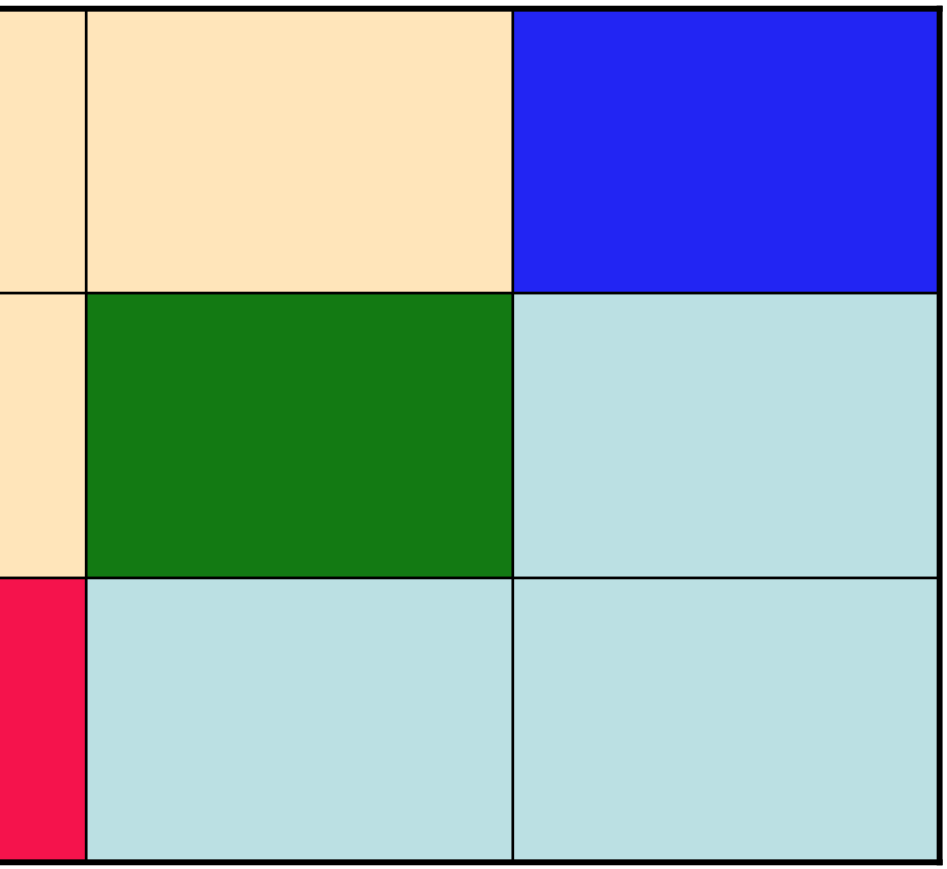



GEORGE SHULTZ


MICHAEL QUINLAN
BRUCE TARTER
JAMES SCHLESINGER

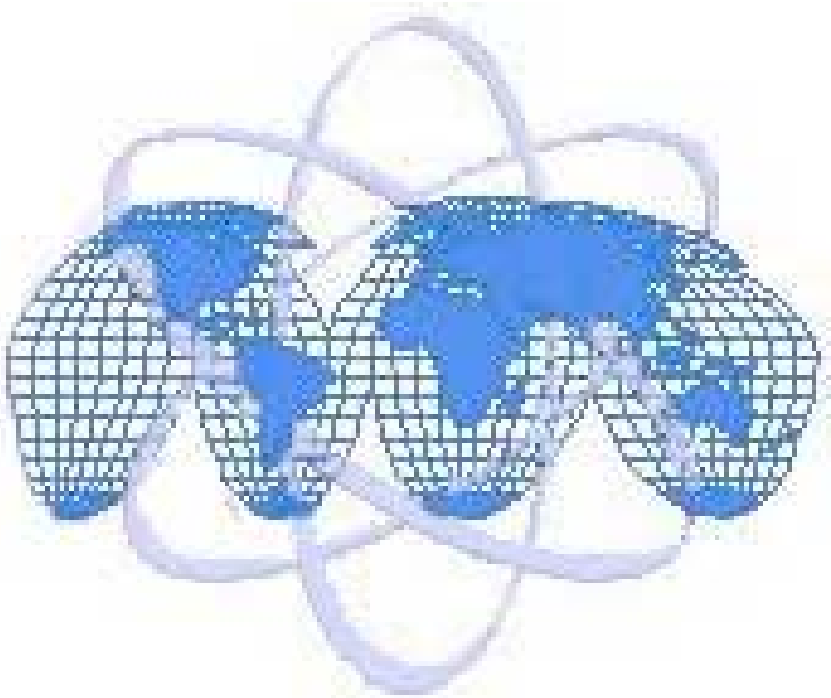


Alternative Nuclear Futures?



Welcome!

The 2003 Futures Project of
the Center for Global Security Research
Lawrence Livermore National Laboratory



"ATOMS FOR PEACE" AFTER FIFTY YEARS: The New Challenges and Opportunities

Ron Lehman 925-422-6141 lehman3@llnl.gov

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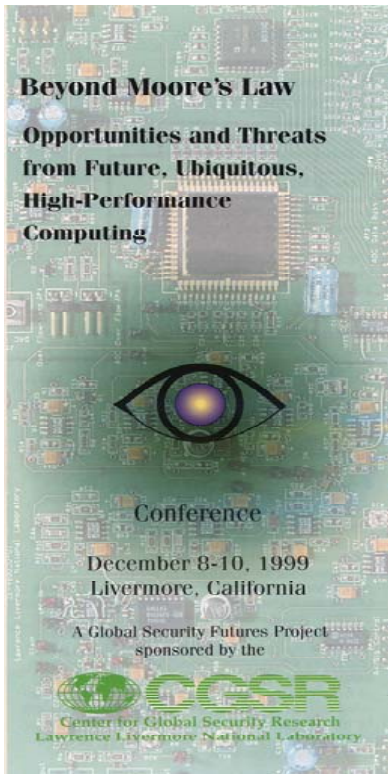
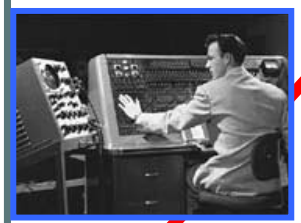
"Brainstorming about the Future, Less to predict than to understand and to shape"





100000000
10000000
1000000
100000
10000
1000
100
MegaFlops
10
1
0.1
0.01
0.001

1952
1962
1972
1982
1992
2002

Univac
DEC PDP8
CDC 3600
CDC 7600
CRAY 1
CRAY YMP
ASCI
IBM PC
Apple 1
Pentium PC
Macintosh G4

"Atoms for Peace"

President Dwight David Eisenhower

UN General Assembly, 8 December 1953

. . . . .

. . . knowledge now possessed by several nations will eventually be shared by others. . .",

. . . . .

". . . capability of devastating retaliation, is no preventive, of itself. . ."

. . . .

". . . a free intermingling of the peoples of the East and the West – the one sure, human way of developing the understanding required for confident and peaceful relations."

. . . . .

". . . meet privately with such other countries as may be 'principally involved,' to seek 'an acceptable solution' to the atomic armaments race . . ."

. . . . .

". . . to the extent permitted by elementary prudence, . . . make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency."

. . . . .

"… a bank of fissionable material can be made essentially immune to surprise seizure."

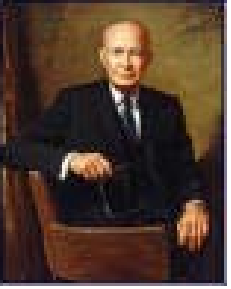
. . . . .

". . . apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world ."

. . . . .

The Big Question:

WHERE ARE THINGS NUCLEAR HEADED NOW?



"ATOMS FOR PEACE"
AFTER FIFTY YEARS:
The New Challenges
And
Opportunities

Can we understand and integrate these?

- INTERNATIONAL SECURITY
  - Defense
  - Proliferation
- CIVILIAN APPLICATIONS
  - Power
  - Medical and other Peaceful Applications
- CROSSCUTTING ISSUES
  - Materials and Waste
  - Governance, Regulation, and Risk

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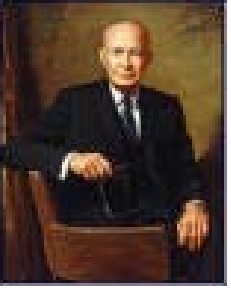
Technology and Context

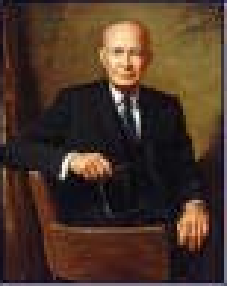
	1953	2003	< 2053
Defense	Bi-polar Sword of Damocles	Weapons of Last Resort; Deep Reductions; Counter WMD	?
Proliferation	3 nuclear states	188 NPT Parties; 9 nuclear states/w half world population	?
Power	nuclear submarine plans	Over 600 nuclear reactors, but growth diminishing	?
Applications	1st Image Intensifiers = real time X-ray imaging	Digital & Genetic revolutions	?
Materials	Shortage	Huge overhang; Waste bottleneck	?
Governance	Cold War concerns prevail	Zero Tolerance, NIMBY	?



Straw Man:
Alternative Nuclear Futures:
Bulls, Bears, or Index Funds?

Will military nuclear programs be

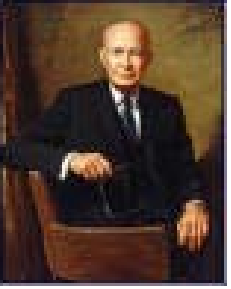
- More Significant?
  - WMD Proliferation and Latency?
  - Asymmetric Response?
  - Multi-polar Spheres of Influence?
  - Nth World Rivalry and Use?
  - Weapons of Alienation?
- About the Same?
  - Legacy systems and platforms?
  - Pace of dismantlement?
  - Evolutionary political change?
- Less Significant?
  - Advanced Conventional Munitions?
  - End of Superpower Face-off?
  - Deep Reductions?
  - Globalization?



Straw Man (continued)

Will nonproliferation accomplishments be

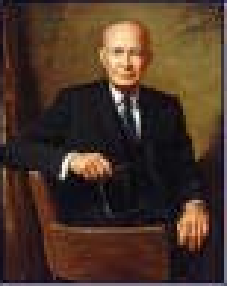
- More Significant?
  - 188 of 194 Nations Party to NPT?
  - Iraq and/or other rollback?
  - NP support regimes (NSG, MTCR, etc)?
  - Rise of economic interests?
- About the Same?
  - Already most people in countries that have nukes?
  - Latent capabilities now long standing?
  - Few additional countries seek capability?
  - Very few WMD Rogues?
- Less Significant?
  - Technology and Talent Spread?
  - Super-terrorism and Fundamentalism?
  - Conflicts of political and economic interests?
  - Loose Nukes and Material?
  - Unraveling of NPT norms and/or enforcement?
  - Wassenaar weaker than COCOM?
  - DPRK? Failed Nuclear States?
  - Non-rogues follow Indian Model?



Straw Man Factors (continued)

Will nuclear power be

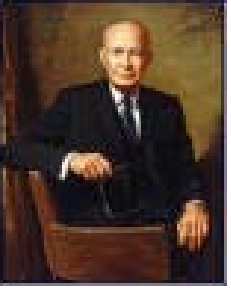
- More Significant?
  - Advanced Reactor Designs?
  - Proliferation resistance enhancements?
  - Hydrogen Economy?
  - Climate Change?
  - New Governance and Risk Mitigation?
  - Yucca Mountain and Regional Repositories?
- About the Same?
  - Legacy Reactors, Waste, and Materials?
  - Long Lead times for Reactors?
  - Longer Lead times for Waste Disposal?
  - Persistence of Proliferators?
  - Permanent Bureaucracy?
- Less Significant?
  - Vulnerability to terrorism?
  - Globalization of NIMBY?
  - Rise of Renewable Energy Sources?
  - Tight EIS and health standards?
  - Opportunity Cost for Capital?



Straw Man Factors (continued)

Will non-power nuclear technology be

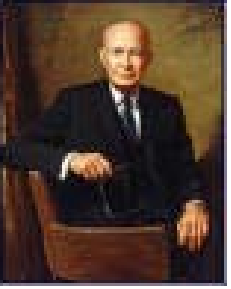
- More Significant?
  - Reduced dose, precise applications?
  - Higher contrast imaging?
  - Digital data bases and networked experts?
  - Artificial Intelligence adjuncts?
  - Hormesis?
- About the Same?
  - Sunk equipment costs with expensive alternatives?
  - Waste disposal bottleneck?
  - Established protocols, regulatory inertia?
- Less Significant?
  - Alternative non-nuclear imaging & diagnostics?
  - Genetic therapy and advanced biochemistry?
  - Tighter security on radioactive materials?
  - Improved modeling of materials and biological processes?



Straw Man Factors (continued)

Will advances in management of material and waste be

- **More Significant?**
  - **Yucca Mountain?**
  - **Regional Repositories?**
  - **Demand for tighter security and safety?**
  - **Waste minimalization?**
- **About the Same?**
  - **Additional sites very limited?**
  - **Material overhang huge, civilian and military?**
  - **No consensus on solutions, especially waste?**
- **Less Significant?**
  - **Transnational NIMBY?**
  - **Global adversary dynamics?**
  - **Legislated Half-life Standards?**

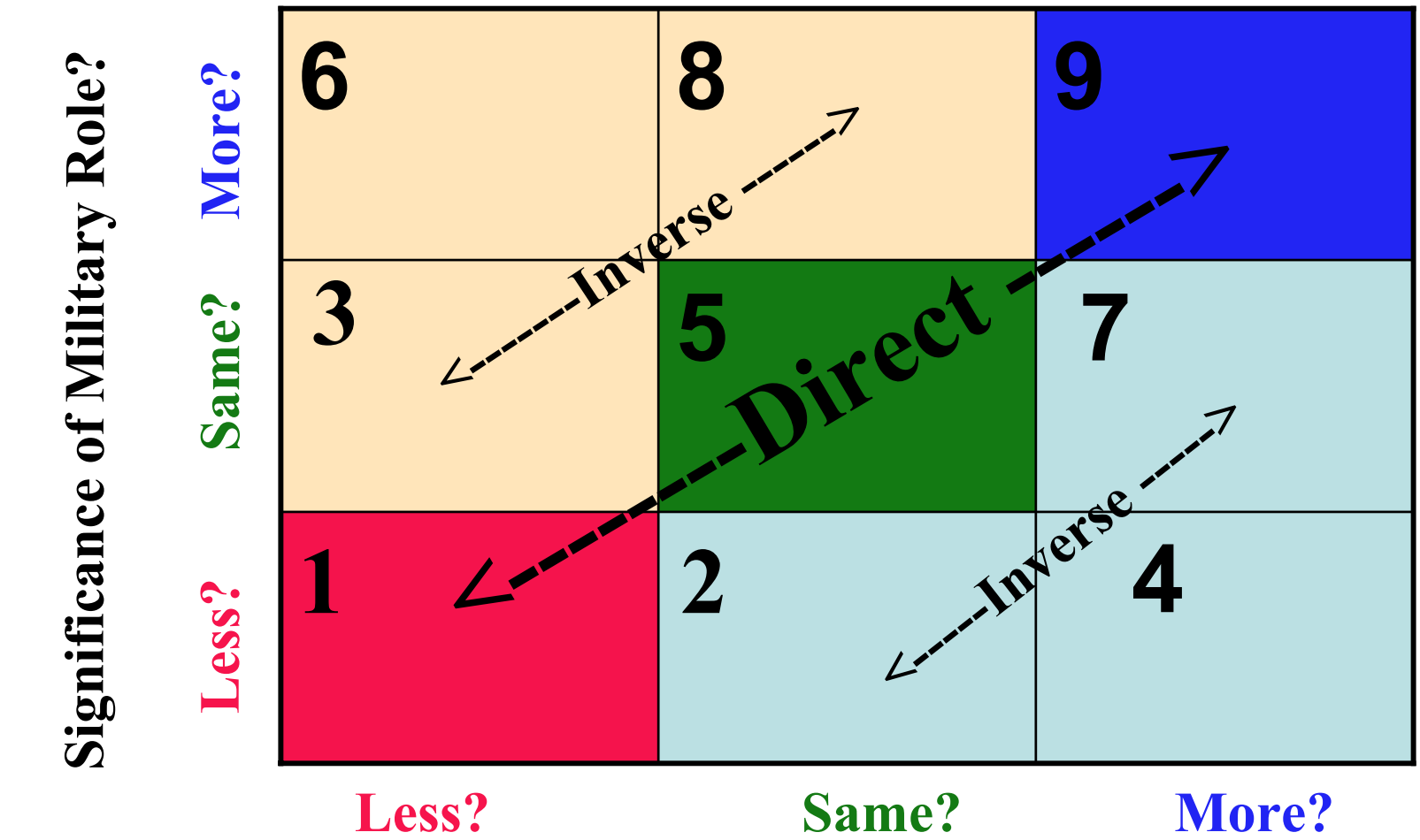


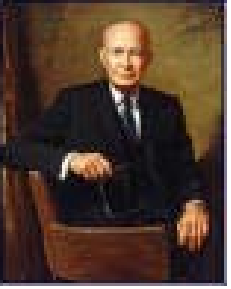
Straw Man Factors (continued)

Will the Effectiveness and Efficiency of Nuclear Governance and Risk Management be

- More Significant?
  - International Norms, ISO and Best Practices?
  - Advances in Low Dose Toxicology?
  - New Governance Processes such as pre-negotiated methodology?
  - Improved Risk Analysis and Modeling?
  - Deregulation and Automation?
- About the Same?
  - Permanent Bureaucracies?
  - Divided Communities including Experts?
  - Adversary Process?
- Less Significant?
  - Polarized Risk Tolerance?
  - Competing Interests?
  - Applied Nuclear Technology not competitive now w/ IT & Biotech, etc. for investment and talent?

Alternative Nuclear Futures?





Seek Clarity, not Consensus

What do we know?
What don't we know?
What most do we need to find out?

Views are those of participants,
Not necessarily those of CGSR, LLNL, UC, NNSA, DOE, USG, etc.

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CURRENT ROLLING TEXT GUIDELINES

Technology <----> Context; Both

Integrate Security, Civilian, & Crosscutting

Objective conditions, but also different perceptions

International scope, not just US

History and Background OK

Seek Insights into Transforming Forces/Issues/Events

Time scales flexible, not just 50 yrs, perhaps actionable horizons

Participants make assertions & justify

Counter assertions & justifications incorporated

Can try to resolve, but not necessary

Should try to identify reasons for different views

Good to identify info that might resolve differences

Chairs brief summary, but all comment & want all participants' views in text

Would like to highlight differences in text

Should emphasize a few highly leveraged forces or uncertainties

Can add appendix for data, expanded views

Like conceptual charts, can consider other documents

Will put all on website for participants

Japan, France, DC, Livermore should have increasingly polished text

Rolling Text should include Executive Summary:

One-sentence? One pager? Ten pager?